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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Application Number: 09/737,512
Filing Date: December 15, 2000
Appellant(s): ESCHBACH, REINER

Steven M. Haas
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed September 9, 2005 appealing from the Office action mailed April 7, 2005.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

5,815,671	Lieberman et al.	2-1993
5,708,693	Aach et al.	1-1998

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 7 and 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lieberman (US Patent 5,185,671) in view of Aach (US Patent 5,708,693).

Regarding claim 7: Lieberman discloses receiving input data that define an input image (column 3, lines 20-25 of Lieberman) that exhibits uneven exposure (column 5, lines 1-4 of Lieberman); deriving from said input data (i(x',y')) lightsource data (E(x',y')) that represent an image of a lightsource in said input image (column 3, lines 37-43 of Lieberman); and deriving enhanced data that represent an enhanced version of said input image (column 5, lines 7-12 of Lieberman), said enhanced data obtained by removing the effect of said lightsource data from the input data (column 4, lines 62-65 of Lieberman).

Further, Lieberman discloses that said lightsource data is in the low spatial frequency region (column 4, lines 65-67 of Lieberman); performing a Fourier transform operation on said image data to define said image data in a frequency domain (figure 3(52) and column 4, lines 6-9 of Lieberman); applying a homomorphic filter to said image data (figure 3(54) and column 4, lines 9-14 of Lieberman); and performing an inverse of said Fourier transform operation on said homomorphically-filtered image data to define said homomorphically-filtered image data in a spatial domain (figure 3(56) and column 4, lines 17-19 of Lieberman).

Lieberman does not disclose expressly that said step of deriving lightsource data comprises subsampling said input data to obtain subsampled data defining a subsampled image; low-pass filtering said subsampled data; and upsampling said low-pass filtered data to derive said lightsource data that define a full-scale image of said lightsource. Further, Lieberman does not disclose expressly that said step of low-pass filtering comprises performing a Fourier transform operation on said subsampled data to define said subsampled data in a frequency domain; low-pass filtering said subsampled data in the frequency domain; and performing an inverse of said Fourier transform

operation on said low-pass filtered subsampled data to define said low-pass subsampled data in a spatial domain.

Aach discloses subsampling input data to obtain subsampled data defining a subsampled image (column 7, lines 54-56 of Aach); and low-pass filtering said subsampled data (column 7, lines 51-55 of Aach). Aach discloses low-pass down-sampling filters (figure 2(101,102) of Aach) which perform both the low-pass filtering and down-sampling operations (column 7, lines 51-55 of Aach) to provide a low-pass down-sampled signal (column 7, lines 55-56 of Aach). Aach does not explicitly state which operation occurs first, but states that both occur (column 7, lines 51-55 of Aach). In fact, performing either low-pass filtering and then down-sampling or down-sampling and then low-pass filtering will achieve the same result since down-sampling will not affect the low-frequency nature of the illumination. Hence, low-pass filtering and down-sampling are independent of each other and can be performed in either order.

Aach further discloses upsampling said low-pass filtered data (column 7, lines 56-60 of Aach).

Lieberman and Aach are combinable because they are from the same field of endeavor, namely image data processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use the method of Aach, namely

down-sampling, low-pass filtering, and then up-sampling with an interpolator, on said lightsource data taught by Lieberman. This will result in the derivation of said lightsource data that define a full-scale image of said lightsource. The motivation for doing so would have been to reduce the level of noise in the overall image while preserving small details of said image (column 1, lines 65-67 of Aach). Further, at the time of the invention, it would have been obvious to a person of ordinary skill in the art to sub-sample the image data before low-pass filtering, as taught by Aach, which would result in the use of a low-pass filter instead of the specific homomorphic filter taught by Lieberman. Since sub-sampling the image data occurs before the low-pass filtering, the Fourier transform taught by Lieberman would be performed on sub-sampled image data and the inverse Fourier transform would be performed on low-pas filtered sub-sampled data. The motivation for doing so would have been to reduce the level of noise in the overall image while preserving small details of said image (column 1, lines 65-67 of Aach). Therefore, it would have been obvious to combine Aach with Lieberman to obtain the invention as specified in claim 7.

Regarding claim 10: Lieberman discloses that said step of deriving enhanced data comprises subtracting said lightsource data from said input data (column 4, lines 28-34 and lines 60-63

of Lieberman). A linear filter is used to remove the illumination components (column 4, lines 60-63 of Lieberman) which are expressed in a linear form after logarithmic conversion to the density domain (column 4, lines 28-34 of Lieberman). In order to filter the illumination component (ln[E(x',y')]) in the logarithmic form (column 4, equation 4 of Lieberman), said illumination component would have to be subtracted from said input data (ln[i(x',y')]).

Further regarding claim 11: Subtracting said lightsource data from said input data in the density domain, said density domain relation expressed in equation 4 in column 4 of Lieberman, is the same as dividing said input data by said lightsource data in the reflectance domain, said reflectance domain relation expressed in equation 2 in column 3 of Lieberman.

Regarding claim 12: Lieberman does not disclose expressly that said step of upsampling said low-pass filtered data to derive said lightsource data that define a full-scale image of said lightsource comprises interpolating said low-pass filtered data using a linear interpolating method.

Aach discloses interpolating said low-pass filtered data using a linear interpolating method (column 7, lines 56-63 of Aach).

Lieberman and Aach are combinable because they are from the same field of endeavor, namely image data processing. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to interpolate low-pass filtered data as part of the step of upsampling. The motivation for doing so would have been to smooth the up-sampled data (column 7, lines 62-63 of Aach) instead of simply using 2x2 blocks of the same pixel values. Therefore, it would have been obvious to combine Aach with Lieberman to obtain the invention as specified in claim 12.

(10) Response to Argument

Appellant, in paragraphs 1-3 under the heading "Independent Claim 7 and Dependent Claim 12", argues that Lieberman only teaches the traditional high-pass homomorphic filtering, which Appellant alleges is "very unreliable and sensitive to image noise" and "very slow and unsuitable for modern image reproduction (printing/copying) applications where throughput must be maximized". Appellant then argues that the high-pass filtering taught by Lieberman already directly removes the effects of lightsource data, and thus no further lightsource removal operations are needed.

In response: Firstly, Appellant has provided no substantive evidence on the record in support of Appellant's

allegations of unreliability and unsuitability. Thus, Appellant's allegations are merely unsubstantiated opinion.

Furthermore, by focusing on Lieberman, Appellant has ignored the combination of Lieberman and Aach as set forth in the final rejection, mailed April 7, 2005. By combination, Lieberman in view of Aach teaches extracting the lightsource data using the down-sampling, low-pass filtering, and up-sampling operations taught by Aach. The high-pass homomorphic filtering taught by Lieberman is *replaced* with the down-sampling, low-pass filtering, and up-sampling operations taught by Aach. This is clearly set forth on page 7, lines 5-17 of said final rejection, which is quoted herein:

> "Further, at the time of the invention, it would have been obvious to a person of ordinary skill in the art to sub-sample the image data before low-pass filtering, as taught by Aach, which would result in the use of a low-pass filter instead of the specific homomorphic filter taught by Lieberman. Since sub-sampling the image data occurs before the low-pass filtering, the Fourier transform taught by Lieberman would be performed on sub-sampled image data and the inverse Fourier transform would be performed on low-pas filtered sub-sampled data. The motivation for

doing so would have been to reduce the level of noise in the overall image while preserving small details of said image (column 1, lines 65-67 of Aach)."

Thus, Appellant's allegations of unreliability and unsuitability are not only unsubstantiated opinion, but also do not substantively relate to the method taught by the combination of Lieberman and Aach. Furthermore, since the high-pass homomorphic filtering taught by Lieberman is replaced with the down-sampling, low-pass filtering, and up-sampling operations taught by Aach, the removal operations are not subsequent to any high-pass homomorphic filtering, since said high-pass homomorphic filtering is not a part of the method taught by Lieberman in view of Aach as set forth in said final rejection.

Appellant, in paragraphs 4-5 under the heading "Independent Claim 7 and Dependent Claim 12", argues that Aach does not mention or even suggest deriving lightsource data from input image data, and therefore does not disclose any removal operation for removing the effects of the lightsource data from the original input data. Applicant further argues that Aach does not teach or suggest a low-pass alternative to conventional high-pass homomorphic filtering.

In response: Aach teaches the removal of noise from digital image data. Lieberman teaches the removal of a specific

type of noise, namely lightsource data, from digital image data. Furthermore, Lieberman teaches that lightsource data is in the low spatial frequency region (column 4, lines 65-67 of Lieberman) [as cited on page 5, lines 14-16 of said final rejection]. Thus, the low-pass filter taught by Aach would act to pass the low-frequency lightsource data taught by Lieberman. The thus extracted lightsource data would then be eliminated from the digital image data by either a subtraction operation [see page 7, lines 19-29 of said final rejection] or a division operation [see page 8, lines 1-7 of said final rejection]. The suggestion to use the alternative approach taught by Aach in the system of Lieberman would come from the fact that the lightsource data taught by Lieberman is in the low spatial frequency region and the low-pass filter taught by Aach can clearly be used to pass said low spatial frequency lightsource data.

Appellant, under the heading "Dependent Claims 10 and 11", argues that the subtraction operation and division operation steps are not taught or suggested by any document of record. Appellant then essentially repeats the arguments with regard to the high-pass homomorphic filtering taught by Lieberman and the down-sampling, low-pass filtering, and up-sampling operations taught by Aach.

In response: The subtraction operation and division operation steps have clearly been taught by Lieberman, as set forth on page 7, line 19 to page 8, line 7 of said final rejection. Appellant has not substantively addressed Examiner's rejections contained therein. Furthermore, Appellant is again ignoring the method that is taught by the combination of Lieberman and Aach, which teaches *replacing* the high-pass homomorphic filtering operation of Lieberman with the down-sampling, low-pass filtering, and up-sampling operations taught by Aach.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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November 4, 2005